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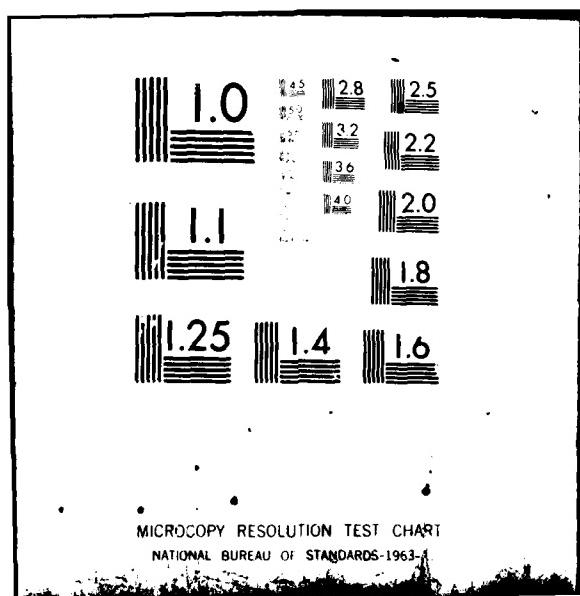
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DRIVER EVALUATION OF THE GOER VEHICLE, CONDUCTED DURING THE FEA--ETC(U)  
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## U.S. Army Armor Human Research Unit Fort Knox, Kentucky

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US Army Armor Human Research Unit  
Fort Knox, Kentucky

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Driver Evaluation of the GOER Vehicle,  
Conducted During the Feasibility Test,

1-1701

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Research Memorandum

Research Memorandum  
February 1960

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## Table of Contents

Introduction	1
Subjects	2
Procedure	2
Driver Proficiency Test	2
Driver Interviews	2
Results	3
Driver Proficiency	3
Interview Data	4
Conclusion	5
Appendix: Student Drivers' Responses to Interview Questions after One Week and after Two Weeks of Training on the GOER	6

## Tables

Table 1: Scores of Subjects on the Army Driver Test  
and the AMRL Driving Course (after Page 2)

Table 2: Times (in Minutes) Required to Complete the  
2.4-Mile Driving Course (after Page 3)

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## **Driver Evaluation of the GOER Vehicle, Conducted During the Feasibility Test**

### **Introduction:**

In August 1959, the US Army Armor Human Research Unit was asked by the US Army Armor Board and the US Army Armor School to take part in an evaluation of a breadboard model of the GOER type of vehicle. In this evaluation, the Armor Human Research Unit dealt with the selection and training of drivers for GOER vehicles.

GOER is a generic name for a proposed family of military wheel vehicles. GOER vehicles are characterized by having large-diameter, low-pressure tires, positive-powered wagon steer, and exoskeletal construction. The vehicles are intended principally as cargo-carriers, capable of handling cargoes of from 5 to 15 or more tons. The GOER concept aims at improved mobility for cargo-carriers, and combines high off-road capabilities with rugged simplicity and durability. The exoskeletal design provides less dead weight than do conventional vehicles of comparable load capacity--the strength of the GOER is in its outer skin rather than in the interior frame. Its unique construction also provides floatability.

Two models built on the GOER concept were evaluated in the test. One vehicle was a 5-ton cargo-carrier, the other a 15-ton tank cargo-carrier. Both vehicles under test were developed by the Le Tourneau-Commercial Corporation (Peoria, Illinois), under the auspices of the Army Ordnance Tank-Automotive Command (Detroit). The vehicles were constructed mainly from available parts of commercial earth-moving equipment. They were intended not as prototypes of military models, but only as preliminary working models which were built to test the feasibility of the GOER concept.

The part which Armor Human Research played in making the evaluation consisted in advising on the selection of student drivers for the GOER vehicles, testing their GOER driving performance, and interviewing them during and at the end of their GOER driver training.

Subjects:

The subjects were personnel assigned to the Sixth Armored Cavalry Regiment (Fort Knox). Seven GOER student drivers were selected from a group of 20 candidates, all of whom had driver's licenses for wheel vehicles, and some experience in operating track vehicles. They were selected by Armor School personnel on the basis of scores on Batteries I and II of the Army Driver Test and on the Army Medical Research Laboratory Driving Course. (See Table 1.) On the basis of these test scores, the men selected may be slightly superior to the population of licensed drivers, but not significantly so from a statistical standpoint. Since only seven drivers were studied, the findings should be considered tentative, and generalizations from the data should be made with caution.

Procedure:

Driver Proficiency Test. The test of the proficiency of the GOER drivers at the end of training was to drive a combination road and cross-country course in a wooded area near the Armor Board field maintenance shop (Carpenter Test Area, Fort Knox).<sup>1</sup> The course is 2.4 miles in length; about .4 mile is improved road, and the remainder is cross-country. None of the drivers had ever driven the course. Two vehicles were used in the test—the 15-ton GOER tanker, fully loaded, and the 5-ton GOER cargo-carrier, unloaded. Each driver who took the test drove each vehicle around the complete course. As he negotiated the course, each driver was evaluated by an NCO who was experienced in operating the GOER vehicles. A record of the times necessary to complete the driving course was made.

Driver Interviews. In addition to testing the driving ability of the student drivers, the Armor Human Research Unit conducted interviews with each trainee.

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<sup>1</sup>This driving course had been used previously by the Armor Human Research Unit in a test to determine average speeds of the medium tank over varying types of terrain.

Table 1  
Scores of Subjects on the Army Driver Test and the AMRL Driving Course

Driver Selected	Army Driving Test		AMRL Driving Course <sup>c</sup>
	Battery I <sup>a</sup>	Battery II <sup>b</sup>	
1	104	110	117
2	116	115	135
3	128	121	146
4	146	107	164
5	104	101	148
6	124	124	89
7	144	117	107
Mean Score	123.7	113.6	129.3
General Population Mean Score	110 <sup>d</sup>	110 <sup>e</sup>	f

<sup>a</sup>Battery I consists of three tests—on driving know-how, self description, and attention to detail—and the age of the driver.

<sup>b</sup>Battery II consists of three tests—on emergency judgment, visual judgment, and two-hand co-ordination.

<sup>c</sup>The AMRL Driving Course was developed by Dr. Marvin J. Herbert in connection with a study of driving fatigue. It yields a combination score on a number of driving skills tests.

<sup>d</sup>An estimate, based on the scores of 228 men selected more or less at random from 1st Training Regiment, USATCA (H/S Company, and Companies A and B, 1st Battalion).

<sup>e</sup>Based on the subjects tested by US Army Armor Center (Driver Testing Section) during November 1959.

<sup>f</sup>These results merely demonstrate a range of driver ability. No norms for this test have been established to date.

The purpose of these interviews was to determine the trainees' opinions of the vehicle,<sup>2</sup> their ability to operate and maintain it, and their training on it.

Each of the seven trainees was interviewed twice, once at the end of the first week of training, and again at the end of training. At the time of the first interview, each trainee had had approximately two and one-half hours of driving experience. By the time of the second interview, he had had approximately seven hours.

The purpose of repeating the interviews was to provide an indication of the direction in which the men's opinions may have changed during their training. The same interviewer and the same interview schedule were employed for both interviews.

Results:

Driver Proficiency. The results indicate no particular statistically significant relationship between the senior NCO's evaluation of the drivers and their scores on Battery I, Battery II, and the Army Medical Laboratory Driving Course. (See Table 2.) Nor did the evaluation by the NCO who accompanied the drivers seem to be related to the time it took to drive the course. There do, however, seem to be consistent findings, considering the time measures themselves. The 5-ton unloaded vehicle was driven over the course in the average time of 22.4 minutes, for an average speed of 6.4 miles per hour. The 15-ton loaded vehicle was driven over the course in an average time of 35.4 minutes, for an average speed of 4.1 miles per hour. Previous experience—using drivers who had completed Advanced Individual Training, Armor, and driving M48A1 tanks over this area during daylight with hatches open—has shown that on the average 16.5 minutes are required, at an average speed of 8.7 miles per hour. The differences between speeds with which the

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<sup>2</sup>Although the trainees received instruction and practice on the 5-ton as well as the 15-ton GOER, the questions referred only to the 15-ton vehicle. No distinction was made, however, between the tanker and the cargo-carrier.

Table 2  
Times (in Minutes) Required to Complete the 2.4-Mile Driving Course<sup>a</sup>

Driver	15-Ton GOER (Loaded)	5-Ton GOER (Empty)	Evaluation of Over-All Driver Performance <sup>b</sup>
1	30	24	Average
2	47	26	Above Average
3	30	19	Below Average
4	36	21	Average
5	35	22	Above Average
6	32	22	Above Average
7	38	23	Average
Mean Time	35.4	22.4	
Rate in Miles per Hour	4.1	6.4	

<sup>a</sup>The medium tank referred to in the text traveled the same course at an average speed of 8.7 miles per hour (40 trials).

<sup>b</sup>The evaluations were made by experienced NCO's (drivers).

two GOER vehicles completed the course probably reflect reasonably accurate differences between the two vehicles, for they were driven over the same course by the same drivers. Differences in GOER speeds and tank speeds are less clear, since different drivers were used. The data do suggest, however, the relative differences between the speeds of the various vehicles. Since it is intended that GOER vehicles be able to follow tanks at normal speeds cross-country, these differences in speed may be of importance in evaluating the effectiveness of the present GOER models tested.

Interview Data. The interview questions were designed to secure information in three general areas:

1. The trainee's confidence in his ability to operate the vehicle.
2. The trainee's estimate of his proficiency and state of training in operating and maintaining the vehicle.
3. The trainee's report of special difficulties or problems which he encountered on the vehicle or in his training.

The responses of the seven drivers to the interview questions are listed in the appendix. Because of the small number of men involved, no attempt has been made to analyze the responses statistically.<sup>3</sup> The following comments, therefore, and any other interpretations of the data, should be regarded only as tentative or suggestive.

1. As indicated by their responses to Question 2, the trainees' confidence in their ability to drive the GOER appeared to increase as training progressed. At the end of training, most of them said they handled the GOER about as well as the M48 tank. But a majority regarded the GOER as a more difficult vehicle to drive than the M48, and as requiring somewhat more interval in convoy. (See Questions 8 and 12.)

2. The men's estimates of how long they could drive the GOER without relief

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<sup>3</sup>On the basis of a sample of seven men, no division of responses except seven-zero would meet conventional standards of statistical significance.

tended to decrease as their training and driving experience increased. (See Question 3.) This tendency may be related to reports of heat discomfort. (See Question 4.)

3. Reports of difficulty in using controls or reading instruments were infrequent. (See Questions 5 and 6.)

4. The trainees' estimates of the amount of further training they needed in order to become proficient in operating the GOER tended to decrease. Even after the completion of the training, however, substantial numbers reported a need for further training in most operations. (See Question 7.)

5. Although reports of difficulty in steering the vehicle decreased as training increased, a substantial number of men continued to report both general and specific difficulty in steering. (See Questions 9 and 10.) These difficulties appear to apply at lower as well as higher speeds.

6. Responses concerning difficulties in using the GOER transmission appear to be negligible.

Conclusion:

At the completion of driver training, the trainees could effectively negotiate GOER vehicles over various types of terrain and under various road conditions; confidence in ability to drive the GOER also increased as training progressed. It should be emphasized that preliminary models illustrating the GOER concept were being evaluated, but that exact specifications for such new Army equipment or vehicles which utilize the GOER concept have not been finally determined; part of the purpose of this evaluation was to point out deficiencies in the vehicle, and to point toward general improvements in this type of vehicle.

APPENDIX: Student Drivers' Responses to Interview Questions after One Week  
and after Two Weeks of Training on the GOER

Question 1a: What is the fastest speed at which you have ever driven the GOER?  
First Interview      Second Interview

- |   |   |
|---|---|
| A, about 5 miles per hour                 |   |
| B, about 10 miles per hour                |   |
| C, about 15 miles per hour                |   |
| D, about 20 miles per hour                | 1 |
| E, about 25 miles per hour                | 2 |
| F, about 30 miles per hour                | 4 |
| X, I have never driven the vehicle at all | 6 |

Question 1b: What is the fastest speed at which you have ever driven the M48 tank?  
First Interview      Second Interview

- |   |   |
|---|---|
| A, about 5 miles per hour                 |   |
| B, about 10 miles per hour                |   |
| C, about 15 miles per hour                | 1 |
| D, about 20 miles per hour                |   |
| E, about 25 miles per hour                | 2 |
| F, about 30 miles per hour                | 4 |
| X, I have never driven the vehicle at all |   |

Question 2: How confident are you that you could handle the GOER and the M48 tank at 15 miles per hour and at 30 miles per hour?

- A, very confident  
B, fairly confident  
C, not very confident  
D, not confident at all

First Interview

GOER, 15 mph				
	A	B	C	D
M48	A	4	1	
Tank,	B	1	1	
15	C			
mph	D			

GOER, 30 mph

	A	B	C	D
M48	A	2	2	
Tank,	B	2	1	
30	C			
mph	D			

Second Interview

GOER, 15 mph				
	A	B	C	D
M48	A	5	1	
Tank,	B			1
15	C			
mph	D			

GOER, 30 mph

	A	B	C	D
M48	A	2	1	
Tank,	B		4	
30	C			
mph	D			

<sup>1</sup>Question 11, "How do you think the steering of the GOER could be improved to make it easier to use?" is not included. In answer to this question the drivers, instead of making suggestions for improvement, said that additional practice in driving would enable them to adjust to the steering mechanism of the GOER.

Question 3: How long do you think you could drive the GOER over rough terrain without relief?

	<u>First Interview</u>	<u>Second Interview</u>
A, less than two hours	1	0
B, more than two hours but less than three hours	0	3
C, more than three but less than four	1	2
D, more than four but less than five	3	2
E, more than five but less than six	1	0
F, six hours or more	1	0

Question 4a: Did you experience any physical discomfort while driving this vehicle?

	<u>First Interview</u>	<u>Second Interview</u>	
<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>
7	0	6	1

Question 4b: Which of the following caused you any physical discomfort?

- A, very small amount
- B, small amount
- C, large amount
- D, very large amount of discomfort

	<u>First Interview</u>				<u>Second Interview</u>			
	A	B	C	D	A	B	C	D
Heat	2	4	1		2	3	1	
Noise								
Fumes								
Position while driving	1	1						
Glare					1			
Vibrations	1		1					

Question 5a: Did you have difficulty in reading any of the instruments in the driver's compartment?

	<u>First Interview</u>	<u>Second Interview</u>	
<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>
1	6	0	7

Question 5b: Which instruments did you have difficulty reading and how much?

- A, a little difficult
  - B, fairly difficult
  - C, very difficult
- |                            | <u>First Interview</u> | <u>Second Interview</u> |
|----------------------------|------------------------|-------------------------|
| Predictor indicator lights |                        |                         |
| Head lights                |                        |                         |
| Light dimmer               |                        |                         |
| Brake switch               |                        |                         |
| Ignition switch            |                        |                         |
| Brake light                |                        |                         |
| Bilge pump                 |                        |                         |
| Airshirt buttons           |                        |                         |

No instrument difficulties were specified.

Question 6a: Did you have difficulty in using any of the controls?

	<u>First Interview</u>	<u>Second Interview</u>	
<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>
6	1	2	5

Question 6b: Which controls did you have difficulty using and how much?

- A, a little difficult
- B, fairly difficult
- C, very difficult

	<u>First Interview</u>			<u>Second Interview</u>		
	A	B	C	A	B	C
Steering wheel	1	3	1			
Accelerator	3	1	1		1	
Shifting (rear assist)						1

Question 7: How much more training do you think you will need on the GOER before you become proficient in the following operations?

- A, no more training
- B, a little more training
- C, quite a bit more training
- D, a great deal more training

	<u>First Interview</u>				<u>Second Interview</u>			
	A	B	C	D	A	B	C	D
Starting	7				7			
Stopping	3	4			5	2		
Shifting	2	5			3	4		
Braking	1	5	1		2	5		
Steering		3	2	2	2	5		
Before operations maintenance	5	2			3	3	1	
During operations maintenance	2	4	1		3	3	1	
After operations maintenance	5	2			3	2	1	1

Question 8: How would you compare the difficulty you have driving the GOER to the difficulty you have driving the M48, 3/4-ton truck and 1/4-ton truck?

	<u>First Interview</u>			<u>Second Interview</u>		
	More	Less	Same	More	Less	Same
M48 Tank	5	2		5		2
3/4-ton Truck	7			6		1
1/4-ton Truck	7			6		1

Question 9a: How much difficulty do you have steering the GOER?

	<u>First Interview</u>			<u>Second Interview</u>		
	More	Less	Same	More	Less	Same
A, no difficulty at all					1	
B, a little difficult				4		6
C, fairly difficult						
D, very difficult				3		

Question 9b: How much difficulty did you have steering the GOER under the following terrain and road conditions?

- A, no difficulty at all
- B, a little difficult
- C, fairly difficult
- D, very difficult

	<u>First Interview</u>				<u>Second Interview</u>			
	A	B	C	D	A	B	C	D
Hard surface at more than 15 mph	1	3	2	1	4	3		
Hard surface at less than 15 mph	1	4	2		4	3		
Sharp curves	3	2	1	1	3	2	2	
Congested areas	1	2	2	1	4	1	2	
Narrow trails	2	2	2	1	2	4	1	
Rough terrain	2	4		1	3	3	1	
Wet surfaces	2	2	2	1	3	2	1	1

Question 10: When you steer the GOER how often do you tend to do each of the following?

- A, hardly ever
- B, once in a while
- C, quite frequently
- D, almost always

	First Interview				Second Interview			
	A	B	C	D	A	B	C	D
Turn too sharply on curves	4	3			4	2	1	
Continually apply corrective steering	1	2	2	2	2	2	2	1
Be over-cautious approaching curves	3	2	2		3	3		1
Take curves too fast	3	4			7			
Skid	7				7			
Over steer		2	2					
Go too fast to down shift	1				1			

Question 12: If you were driving an M48 and/or the GOER in convoy at 30, 20, and 10 mph respectively, how much distance do you think you would need between vehicles in order to safely make an emergency stop?

Interval needed by GOER would be:	First Interview <sup>2</sup>			Second Interview		
	More	Less	Same	More	Less	Same
30 mph	3	1	2	4	1	2
20 mph	4	1	1	3	1	3
10 mph	3	1	2	4	1	2

Question 13: How much difficulty did you have using the clutch?

	First Interview		Second Interview	
	More	Less	More	Less
A, no difficulty at all	3		6	
B, a little difficult	4		1	
C, fairly difficult				
D, very difficult				

Question 14: How much difficulty did you have in co-ordinating the manipulation of the shift lever, splitter, and air shift button?

	First Interview		Second Interview	
	More	Less	More	Less
A, no difficulty at all	3		5	
B, a little difficult	4		2	
C, fairly difficult				
D, very difficult				

Question 15: How much difficulty did you have selecting the correct gear?

	First Interview		Second Interview	
	More	Less	More	Less
A, no difficulty at all	5		6	
B, a little difficult	2		1	
C, fairly difficult				
D, very difficult				

<sup>2</sup>One driver (first interview) had no idea of the distances required.

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This memorandum discusses a project to evaluate a model cargo-carrier vehicle characterized by large-diameter, low-pressure tires, positive-powered wagon steer, and exoskeleton construction. It describes in particular the selection, proficiency testing, and interviewing of student-driver trainees. Selection criteria are reviewed; results of proficiency tests and of interviews conducted during and after the training are reported. An appendix presents responses to both interview rounds.		

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